

Name: \_\_\_\_\_

## **NASA/Tropical Rainfall Measuring Mission (TRMM)**

### **Topic #2: Hurricanes as Heat Engines**

#### **Activity #1: How do hurricanes convert heat into a powerful storm?**

National Science Content Standards A,B,D,E,F&G

**OBJECTIVE:** To identify the role of latent heat as the energy source for the strength of a hurricane.

**BACKGROUND:** Hurricanes draw their power from the heat in warm humid air found over tropical oceans. These warm oceans with **water temperatures above 80 F** provide conditions for steady evaporation into water vapor. This process of evaporation converts (changes) the heat from the oceans into **latent heat that is stored in the water vapor**. The latent heat is taken up as the water changes phase from a liquid to a gas. An area of low pressure develops as the warm, unstable **water vapor rises**. **Winds come together - converge - to replace the rising air**. The rising air cools and condenses into cloud droplets and rain. During condensation the **water vapor releases the stored latent heat**. The release of this **latent heat is the key source of energy for the storm**. This newly **released heat warms the surrounding higher altitude air** making it more likely to rise. The updrafts (vertical winds) bring a continual source of latent heat that is “stored” in the water vapor. Heavy rains result as the humid rising air condenses to form clouds. This process continues to repeat itself until the hurricane no longer has a source of warm humid air. The storm’s dependency on warm water vapor causes hurricanes to lose their strength when they move over cooler oceans or over land. The hurricane could be compared to an engine as it uses the latent heat in humid air as fuel in a process that produces powerful winds and rain.

NASA’s Tropical Rainfall Measuring Mission (TRMM) utilizes remote sensing from a satellite to measure rainfall and latent heat in the tropical regions of Earth. Due to the destructive nature of hurricanes, scientists will use data from hurricane observations to better understand these storms. For example, it has been observed that huge towering clouds developed around the eye (center) of Hurricane Bonnie just before the storm intensified (increased strength). Observations such as these could help meteorologists with predicting the severity of an approaching storm. Also, as our concern for **rising global temperatures** increases, scientists are interested in the relationship between warmer temperatures and hurricanes. Since hurricanes draw their strength from warm water, global warming could result in **more frequent or more powerful storms**. Scientists will use the increased satellite data to create computer models that may help answer these questions.

**MATERIALS:** “Diagram”, “Hurricane Conditions for Diagram”, scissors, glue

How do hurricanes convert heat into powerful storms?

**PROCEDURE:**

1. Cut out the pieces representing the conditions necessary for hurricane formation.
2. Glue the pieces to the diagram by matching the letters. Allow the pieces to flip up to access the information below.

**ANALYSIS:**

1. Describe the repeating process which releases latent heat from rising warm air.
2. Why do hurricanes produce strong winds and heavy rain?
3. Why do hurricanes lose their strength over cooler water or land?
4. How might increased global temperatures affect hurricanes?
5. Consider the conditions necessary for hurricanes to develop. Explain why hurricanes begin in the tropical regions of Earth.
6. Describe the importance of the new discovery by TRMM scientists during their observations of Hurricane Bonnie?